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(54) **Liquid heating apparatus**

Flüssigkeitserhitzer

Appareil pour chauffer un liquide

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Description

This invention relates to a liquid heating apparatus in which a heat exchanger, such as boiler, making use of combustion gas up/down-draft method is installed within a water tank.

The liquid heating apparatus described above includes those proposed by this applicant and disclosed in (A) the Japanese Utility Model Publication No. 44093/1973 and (B) the Japanese Utility Model Publication No.15168/1976. What is disclosed in (A) is the one as shown in FIGS.9 to 12, with a heat exchanger 21 provided in a water tank 22; said heat exchanger 21 comprising a partitioned water chamber 25 provided within an internal void section surrounded by a heat receiving wall 23 with the upper section and both sides of the lower section communicated with a communicating tube 24 and a water through hole 30 respectively to a water tank 22, a combustion chamber 26 communicated to a gas up-draft chamber 29 having a narrow upper section formed in one side thereof and a gas down-draft chamber 27 having a narrow lower section formed in the other side with upper sections of the two chambers 27 and 29 communicated to each other with gas through holes 28 formed in both sides of the communicating tube 24, a combustor 33 provided in the lower section of the combustion chamber 26 with an air supply path 31 to the combustion chamber 26 and an exhaust path 32 to the gas down-draft chamber 27 each provided in the lower section thereof.

Description is made hereinafter for phenomena in up/down-draft of combustion gas in the heat exchanger 21 as described above. In a gas combustion path having the gas up-draft chamber 29 shown in FIG.11 and the gas down-draft chamber 27 having the same height H as that of the gas up-draft chamber, it is known that an internal draft power Pch as expressed by the following equations (1) and (2) is generated, assuming a heat generating point U, a middle point M, and an exhaust point D:

$$Pch = (\gamma d - \gamma u) . H \tag{1}$$

$$Pch = (PH/R)\ (1/Td - 1/Tu) \tag{2}$$

Herein;

- γd: Specific weight of combustion gas in the gas down-flow chamber 27
- γu: Specific weight of combustion gas in the gas up-flow chamber 29
- H: Height of the middle point M from the heat generating point U
- P: Pressure of the combustion gas
- R: Constant for the combustion gas
- Td: Temperature of the combustion gas in the gas down-flow chamber 27
- Tu: Temperature of combustion gas in the gas up-flow chamber 29

As Tu is always higher than Td (Tu > Td), when the heat exchanger 21 is working, namely when the combustor 33 is working, (1/Td - 1/Tu) > 0, and the combustion gas flows from the heat generating point U to the middle point M and to the exhaust point D. In contrast to it, when operation of the heat exchanger 21 is down, Tu = Td = Temperature of peripheral water, and for this reason the internal draft power Pch = 0, so that a combustion gas in a combustion gas path stops flowing and resides therein, which is useful in preventing cool air from coming in from the outside and keeping the internal temperature at a level.

What was described above is based on this principle, and a combustion gas generated within the combustion chamber 26 goes up in the gas up-draft chamber 29 and then goes down in the gas down-draft chamber 27 radiating heat with the temperature of the gas becoming lower and the weight becoming heavier and is exhausted through a tunnel 34 from the exhaust path 32 to the outside, and in this process the combustion gas contacts the heat receiving wall 23 and walls of the partitioned water chamber 25 to heat water within the water tank 22, so that the heat exchange is high, temperature of the water goes up rapidly, temperature drop of a combustion gas while flowing is large with the down-draft fluidity raised and the draft function promoted, and in addition as the two paths 31 and 32 adjoin each other, a supply air flowing in the air supply path 31 is heated by exhaust gas flowing in the gas exhaust path 32 with the combustion efficiency raised, which is another merit of the system above.

In the apparatus disclosed in (A) above, however, the partitioned water chamber 25 is flat, so that the heat transfer area is small and the heat transfer efficiency is low, and in addition as there is a clearance between a bottom face of the water tank 22 and that of the heat exchanger 21, convection fault occurs in the water residing in this section, which prevents all portions of the water from being heated homogeneously, and heat exchange is carried out more smoothly in the heat receiving wall 23 in the side of gas up-draft chamber 29 which is located in the opposite side to the heat receiving wall 23 and where water convection is carried out more smoothly than in the heat receiving wall 23 in the

side of gas down-draft chamber 27 which is located near a wall face of the water tank 22 and where water convection is not carried out smoothly, and as a result combustion gas residing in the gas up-draft chamber 29 is cooled, and a satisfactory draft power can hardly be obtained.

Furthermore in the apparatus described above, if the exhaust point D (Fig. 12) is located at a position higher by the range h from the exhaust point D (Fig. 11), pressures Pu, Pm and Pd at points U, M and D respectively are calculated from the aforesaid equations (1) and (2) as follows.

$$Pu = Pm + \int_0^H \gamma u . dH \qquad (3)$$

$$Pd = Pm + \int_h^H \gamma d . \, dH = Pm + \gamma d.H - \gamma d.h \qquad (4)$$

As Pd is released to the atmosphere, Pd = Po (Atmospheric pressure). For this reason, the following equations are provided:

$$Po = Pm + \gamma d.H - \gamma d.h \qquad (5)$$

$$Pm = Po - \gamma d.H + \gamma d.h \qquad (6)$$

and applying these into the equation (3), the following equation can be obtained.

$$Pu = Po - \gamma d.H + \gamma d.h + \int_0^H \gamma u \, .dH = Po - \gamma d.H + \gamma d.h + \gamma u.H \qquad (7)$$

Herein, while operations of the heat exchanger 21 are down, γd is equal to γu ($\gamma d = \gamma u$), so Pu = Po + $\gamma d.h$, namely Pu - Po = $\gamma d.h > 0$, so that the relation of Pu > Po is always maintained, and the combustion gas in the combustion gas path always flow from the heating point U to the middle point M to the exhaust point D without residing in the combustion gas path, and for this reason intrusion of the external air into the inside is not prevented and heat of hot water inside the water tank 22 is radiated to the outside.

The apparatus disclosed in (B) above is like the one shown in FIG.13 and FIG.14, wherein an internal drum 67 comprising a dual wall is provided in and at a space from an external drum 66 also comprising a dual wall, a combustion gas down-draft chamber 68 is provided between them, an external water chamber 71 having a hot water outlet port 69 and a water supply port 70 in the upper and lower sections thereof is provided outside of the the combustion gas down-draft chamber 68, a combustion chamber 74 communicating in the upper section thereof to the combustion gas down-draft chamber 68 is provided in the internal drum 67, an exhaust port 75 is provided in the lower section of the combustion gas chamber 68, an exhaust cylinder 78 is connected to this exhaust port 75, and a combustor 77 is provided disconnectably through the inner and outer water chambers 71, 72. The hot water outlet port 69 is connected to hot water reserving sections such as water tanks not shown herein with appropriate pipings, and the numeral 79 indicates a port for cleaning. In the liquid heating apparatus as described above, a combustion gas gradually caused to satisfy the rating by the combustor 77 by means of up/down draft method rises in the combustion chamber 74 with the heat radiated from the combustion gas being absorbed, then reverses in the upper section thereof and flows down at a velocity g (m/sec) in the combustion gas down-draft chamber 68, being accelerated to a velocity G (m/sec) at the exhaust port 75 and exhausted therefrom. On the other hand, water is supplied from the water supply port 70 in the lower section thereof to the outer external water chamber 71, rises in this external water chamber 71 and the internal water chamber 72 communicated thereto with the communicating tubes 73 in the upper and lower sections thereof, while the combustion gas causes temperature of liquid to rapidly rise by raising the heat exchange rate between the combustion gas and the liquid because the combustion gas supplies a liquid in the internal and external water chambers 71, 72 with an enough quantity of heat by means of radiation and contact thermal conduction and the down-draft fluidity of the combustion gas in the combustion gas down-draft chamber 68 is raised, which advantageously improves the

combustion efficiency and prevents incomplete combustion.

The aforesaid apparatus has the advantages as described above, but at the same time it has problems as described below. Namely in this liquid heating apparatus, as water is supplied from the water supply port 70 located in the lower section thereof to the external water chamber 71 and rises in this external water chamber 71 as well as in the internal water chamber 72 communicated with the communicating tubes 73 in the upper and lower sections thereof to the external water chamber 71, interference between cool water rising in the external water chamber 71 and hot water exhausted in the upper section thereof from the internal water chamber 72 and again descending the external water chamber 71 is generated, which prevents water from smoothly convecting in both the internal and external water chambers, and for this reason an efficient heat exchange between the gas and the water can not be achieved, and also as the entire apparatus is monolithically assembled to form a heat exchanging/water reserving section, the work for installment is difficult, and in addition cleaning inside the external water chamber 71 is extremely difficult.

JP-A-2213646 discloses a heat exchanger including an external drum having a dual wall, the said external drum having upper and lower combustion gas distribution chambers defined in upper and lower sections of the dual wall and a combustion gas down-draft chamber therebetween, an internal drum spaced inwardly from the external drum and having a combustion chamber therein, a partitioned inner water chamber defined between said external and internal drums, an outer water chamber defined between the said external drum and an outer casing of the heat exchanger, a water outlet connecting the upper parts of the said water chambers to the exterior of the heat exchanger, a water inlet connecting the lower parts of the said water chambers to the exterior of the heat exchanger, a draft tube connecting the said combustion chamber to a combustion gas distribution chamber, an exhaust tube from the lower part of the external drum, and a support cylinder for a combustor penetrating the said external drum and the said water chambers and a side wall of the internal drum.

With such an arrangement, during operation water flows upwardly from the inlet to the outlet by way of the said inner and outer water chambers.

According to the present invention there is provided liquid heating apparatus comprising a heat exchanger located in a water tank, the said heat exchanger including an external drum having a dual wall, the said external drum having upper and lower combustion gas distribution chambers defined in upper and lower sections of the dual wall and a combustion gas down-draft chamber therebetween, an internal drum spaced inwardly from the external drum and having a combustion chamber therein, a partitioned water chamber defined between said external and internal drums, an upper communicating tube comprising a water outlet penetrating the external drum and connecting the upper part of the said water chamber to the exterior of the heat exchanger, a lower communicating tube comprising a water inlet connecting the lower part of the said water chamber to the exterior of the heat exchanger, a draft tube penetrating the upper part of the said water chamber and connecting the said combustion chamber to the said upper combustion gas distribution chamber, an exhaust tube in the lower part of the external drum, and a support cylinder for a combustor penetrating the said external drum and the said water chamber and a side wall of the internal drum, whereby water in the said tank can circulate from the said water outlet to the said water inlet along the outside of the said external drum, the said exhaust tube and the said combustor support tube extending to the outside of the water tank.

With this arrangement according to the invention water in the water tank is able to flow from the water outlet of the heat exchanger downwardly along the outside of the said external drum, whereby heat exchange between the water in the tank and the external drum occurs repeatedly.

Thus, in apparatus according to the invention, when operation of the heat exchanger is started and the combustor provided in the combustor support cylinder starts working, combustion gas generated in the combustion chamber rises in the internal drum, goes into the upper combustion gas distribution chamber formed by the dual wall of the external drum via the upper draft tube, then is reversed at the upper periphery of the combustion gas distribution chamber and descends in the combustion gas down-draft chamber, enters the lower combustion gas distribution chamber and is exhausted to the outside from the exhaust tube. While the combustion gas rises and descends in the heat exchange as described above, heat exchange is carried out between the combustion gas and water residing in the partitioned water chamber formed between the internal and external chambers, as well as on the external surface of the external drum, and because of this heat exchange, especially combustion gas in the combustion gas down-draft chamber delivers heat to the liquid on the inner and outer sides thereof, whereby the down-draft fluidity is raised and also the combustion efficiency is improved to prevent incomplete combustion. During this process the liquid residing in the partitioned water chamber and on the external surface of the external drum generates convection in which water in the partitioned water chamber and on the outside rises and descends respectively, and for this reason the heat exchange rate between the combustion gas and the liquid is raised and the temperature of the water raised. When operation of the heat exchanger is stopped, then even if the combustion gas residing inside tries to move from the exhaust point to the middle point and to the heating point, namely in the contrary direction to that when the heat exchanger is operating, the combustor provided in the combustor support cylinder suppresses the movement so that the combustion gas resides in the heat exchanger to prevent intrusion of cool air from the outside and also to provide a heat insulating effect, so that heat from hot water in the water tank will never be radiated to the outside.

In one form of the invention the said water tank comprises an external casing surrounding the said heat exchanger to define an external water chamber between it and the said external drum, and a water reserving section connected to the top of the said external casing.

With such an arrangement, when operation of the heat exchanger is started and the combustor starts working, combustion gas generated in the combustion chamber rises in the combustion chamber, is reversed when it enters via the draft tube into the upper combustion gas distribution chamber, descends in the combustion gas down-draft chamber, and is exhausted from the exhaust tube to the outside. On the other hand water in the water reserving section descends in the external water chamber, rises via the lower communicating tube in the internal water chamber, and is discharged via the upper communicating tube to the water reserving section. During this process, the combustion gas delivers an adequate quantity of heat to the liquid in the internal and external water chambers, whereby the down draft fluidity in the combustion gas down-draft chamber is raised and also the combustion efficiency is improved so that incomplete combustion is prevented. Also water flows from the upper water reserving section through the external water chamber, the lower communicating tube, the internal water chamber, the upper communicating tube, and back to the water reserving chamber, and during this process generation of interference between cool water and hot water in the external water chamber is suppressed, smooth convection of water is generated between the internal and external water chambers, active heat exchange between the gas and the liquid is performed with the heat efficiency being improved, and the heat exchange rate between the combustion gas and the liquid is raised so that the temperature of the water is rapidly raised. If works for checking, repairing, and replacement are required in the heat exchanger, the works can be carried out after the heat exchanger is removed from the water reserving section. The combustion support cylinder penetrates the partitioned water chamber, the external drum and the external casing and thus extends to outside of the water tank, being located in the side wall of the internal drum, and the combustor is disconnectably provided in this combustor support cylinder, so that, when operation of the combustor is stopped, even if the combustion gas residing inside the combustor tries to move from the exhaust point (exhaust tube) to the middle point to the heating point (combustor), namely in the direction contrary to that when operation of the heat exchanger is started, the combustor provided in the combustor support cylinder suppresses the movement and causes the water to stay inside the heat exchanger, so that intrusion of cool air from the outside is prevented and a heat insulating effect is provided, and for this reason heat of hot water inside the apparatus will never be radiated to the outside.

In certain preferred embodiments the present invention advantageously provides a liquid heating apparatus wherein the heat transfer area is large and the heat efficiency is high, a space between the base of a water tank and that of the heat exchanger is small so that convection fault of water in this section is at least reduced, and water convection within the water tank is smoothly carried out on the entire surface of the heat exchanger for heat exchange to be carried out more smoothly. As a result, combustion gas in the gas descending chamber is efficiently cooled down, draft power is obtained enough to homogeneously heat all portions of the water in the water tank, and furthermore the combustion gas resides inside the heat exchanger even when operation of the heat exchanger is down so that intrusion of cool air from the outside is prevented. With this heat insulating effect, heat of the hot water inside the water tank is not radiated to the outside, and thus the problems in the conventional type of liquid heating apparatus as described in (A) above are at least reduced.

Preferred embodiments of the invention also provide a liquid heating apparatus wherein water descends in the external water chamber from the water reserving section in the upper section thereof through the communicating tube in the lower section thereof to the internal water chamber and then rises therein and does not rise in the external water chamber so that generation of interference between cool water and hot water in the internal and external water chambers is suppressed, smooth water convection between the internal and external water chambers is generated, excellent heat exchange between gas and fluid is performed so that the heat efficiency is high, and also a heat exchange section can be disconnectably mounted in a water reserving section so that the installation work as well as cleaning work is quite easy, whereby the problems in the conventional type of the liquid heating apparatus as described in (B) are at least reduced.

In the accompanying drawings:

FIG. 1 is a transverse front view of a first embodiment of the present invention;
FIG. 2 is a sectional view of the same taken in the line 2-2 of FIG. 1;
FIG. 3 is a transverse front view of a second embodiment of the present invention;
FIG. 4 is a section view of the same taken in the line 4-4 of FIG. 3;
FIG. 5 is a drawing illustrating positional relations between a heating point, a middle point, and an exhaust point in the same;
FIG. 6 is a transverse front view of a third embodiment of the present invention;
FIG. 7 is a transverse front view of a fourth embodiment of the present invention;
FIG.8 is a front view of a fifth embodiment of the present invention;
FIG.9 is a transverse front view of a conventional type of liquid heating apparatus according to prior art which is

similar to the one according to the present invention;
FIG.10 is a side view of a heat exchange of fig 9;
FIG.11 is a sectional view illustrating a general up/down-draft phenomenon of a combustion gas in the heating apparatus of fig 9;
FIG.12 is a sectional view illustrating a up/down-draft phenomenon in the heat exchange shown in FIG.9 and FIG. 10;
FIG.13 is a transverse front view of another liquid heating apparatus based on the prior art which is similar to the one according to the present invention; and
FIG.14 is a sectional view of the heating apparatus according to fig 13 taken in the line 14-14 of FIG. 13.

In the first embodiment shown in FIG.1, the numeral 1 indicates a water tank, the numeral 2 indicates a heat exchanger provided in this water tank 1, this heat exchanger 2 has an external drum 3 comprising a dual wall, this external drum 3 has upper and lower combustion gas distribution chambers 5,11 in the upper and lower sections of the dual wall, a combustion gas down-draft chamber 16 is formed therebetween, internal drum 4 with a combustion chamber 9 and a combustion gas up-draft chamber 14 formed therein is provided in and at a space from the external drum, a partitioned water chamber 6 is formed between the external drum 3 and the internal drum 4, an upper communicating tube 7 penetrating the external drum 3 and communicating to inside of the water tank 1 is connected to the upper section of the partitioned water chamber 6, a lower communicating tube 8 communicating the lower section of the partitioned chamber 6 to the base of the water tank 1 is provided in the lower section of the external drum 3, an upper draft tube 10 penetrating said partitioned water chamber 6 and communicating the combustion chamber 9 to the combustion gas distribution chamber 5 is provided in the upper section of the partitioned water chamber 6, an exhaust port 12 opened to the outside of the water tank is provided in the lower section of the drum 3, a combustor support cylinder 13 penetrating the partitioned water chamber 6 and extending to the outside of the water tank 1 is provided on a side wall of the internal drum 4, and a combustor 15 is disconnectably provided in this combustor support cylinder 13.

In a liquid heating apparatus having the construction as described above, when operation of the heat exchanger 2 is started and the combustor 15 provided in the combustor support cylinder 13 starts working, a combustion gas generated in the combustion chamber 9 rises in the internal drum 4 and the combustion gas up-draft chamber 14, enters the upper combustion gas distribution chamber 5 formed by a dual wall of the external drum via the upper draft tube 10, is reversed at the upper periphery of said combustion gas distribution chamber 5 and descends in the combustion gas down-draft chamber 16, enters the lower combustion gas distribution chamber 11 and is exhausted to the outside from the exhaust tube 12. While the combustion gas rises and descends in the heat exchanger 2 as described above, heat exchange is carried out between the combustion gas and the liquid residing on the external surface of the external drum 3, i.e. in the water tank 1, the combustion gas in the combustion gas down-draft chamber 16 delivers heat to liquids inside and outside thereof through this heat exchange, so that the down-draft fluidity is raised with the combustion efficient being improved, and during this process the liquid residing in the partitioned water chamber and on the external surface of the drum 3 generates convection in which said liquid inside and outside of the partitioned water chamber 6 rises and descends via the upper and lower communicating tubes 7, 8, so that the heat exchange rate with the combustion gas is raised and temperature of the liquid is rapidly raised. Also as shown in FIG.5, the height H' of the middle point M from the heat generating point U is shorter by h than the aforesaid height H and on the contrary the exhaust point D is located by h lower than the heat generating point U, so that, when operation of the heat exchanger 2 is down, theoretically even if the combustion gas residing in the inside thereof tries to move from the exhaust point D to the middle point M to the heating point U like in prior-art -based liquid heating apparatuses, namely in the direction contrary to that when the heat exchanger 2 is operating, to flow out of the apparatus, the combustor 15 provided in the combustor support cylinder 13 suppresses the distribution, and for this reason the combustion gas continue to stay in the heat exchanger 2, which prevents cool air from coming in from the outside and provides a heat insulating effect, and as a result heat of hot water in the water tank 1 will never be radiated to the outside.

In the second embodiment of the present invention shown in FIG.3 and FIG.4, the lower communicating tube 8 is provided in the exhaust tube 12 in the lower section of the external drum 3, and for this reason the embodiment is not different from the first embodiment, excluding the point that so-called dead water is not generated because the liquid at a base of the water tank 1 is more smoothly distributed and efficiently taken into the heat exchanger 2.

In these embodiments, one heat exchanger 2 is provided to one water tank, but a plurality of heat exchangers 2 may be provided to one water tank, so that the present invention can advantageously be applied to a bath, a hot water swimming pool, a boiler based on a water reserving system, a movable bath, a constant temperature bath, a vapor generator, an absorption refrigerator, a vapor generator, a hot chemicals bath, a hot culturing tank, a concrete solution heating apparatus, and others.

In FIG.6 illustrating the third embodiment of the present invention, the numeral 41 indicates a heat exchanger, the numeral 42 indicates a water reserving section provided disconnectably in the upper section thereof, the heat exchanger

41 has an external drum 51 comprising a dual wall with an external water chamber 60 provided between said heat exchanger 41 and an external casing 43. The external drum 51 has upper and lower combustion gas distribution chambers 45 and 54 formed in the upper and lower sections of the dual wall and a combustion gas down-draft chamber 56 formed therebetween, an internal drum 44 having a combustion chamber 49 therein is provided in and at a space from the external drum 51, an internal water chamber 46 is formed therebetween, an upper communicating tube 47 penetrating the external drum 51 and communicating to a water reserving section 42 is provided in the upper section of this internal water chamber 46, a lower communicating tube 48 communicating the lower section of the internal water chamber 46 to the base of the external water chamber 60 is provided in the lower section thereof, a draft tube 50 penetrating said internal water chamber 46 and communicating the combustion chamber 49 to the upper combustion gas distribution chamber 45 is provided in the upper section of the internal water chamber 46, an exhaust tube 52 penetrating the lower section of the external.drum, communicating to the lower combustion gas distribution chamber 54, and opened to the outside is provided, a combustor support cylinder 53 penetrating the external drum 51 and the external casing 43 and extending to outside of the heat exchanger 41 is provided, a combustor 55 is disconnectably provided in the combustor support cylinder 53, and a cylindri-cal partitioning plate 59 extending to inside of the water reserving section 42 is provided on the upper section of the external casing 43. In the water reserving section 42, a water supply pipe 57 is provided in the lower section thereof, and a hot water outlet port 58 is provided in the upper section thereof. The heat exchanger 41 is disconnectably connected to the water reserving section 42 by connecting the flanges 63 and 64 each provided in the upper section of the external casing 43 and the water reserving section 42 respectively.

In the liquid heating apparatus having the construction as described above, when operation of the heat exchanger 41 is started and the combustor 55 provided in the combustor support cylinder 53 starts working, combustion gas generated in the combustion chamber 49 rises in the combustion chamber 49, is reversed when it enters the upper combustion gas distribution chamber 45 via the draft tube 50 and descends in the combustion gas down-draft chamber 56, and is exhausted to the outside via the lower combustion gas distribution chamber 54 from the exhaust tube 52. On the other hand, water is supplied via a water supply tube 57 into the water reserving section 42, descends in the external water chamber 60 between the partitioning plate 59 and the external casing 43, rises via the lower communicating tube 48 in the internal water chamber 46, and is exhausted via the upper communicating tube 47 into the the water reserving section 42, and during this process temperature of cool water in the external water chamber does not rise, so that interference between the cool water and hot water is suppressed, smooth convection of water between the internal and external water chambers 46 and 60 is generated, the combustion gas delivers an enough quantity of heat to liquid in the internal and external water chambers 46, 60, so that the down-draft fluidity is raised with the combustion efficiency being improved, incomplete combustion is prevented, and thus appropriate heat exchange between a gas and a liquid is carried out, the heat efficiency is raised, and temperature of the liquid is rapidly raised. Also if it is necessary to perform works for checking, repairing and replacement inside the heat exchanger 41, the works are carried out after the heat exchanger 41 is removed from the water reserving chamber 42. Also a combustion support cylinder penetrating the partitioned water chamber the intermediate water chamber and the external casing and extending to outside of the water tank is provided on a side wall of the internal drum, and combustor is disconnectably provided in this combustor support cylinder, so that , when operation of the combustor is down, even if the combustion gas residing inside thereof tries to move from the exhaust point (exhaust tube) to the middle point to the heating point (combustor), namely in the direction contrary to that when the heat exchanger is working, the combustor provided in the combustor support cylinder prevents its distribution and causes the combustion gas to reside in the heat exchanger, so that intrusion of cool air from outside is prevented, a heat insulating effect is provided, and for this reason heat of hot water in the apparatus is not radiated to the outside.

The fourth embodiment of the present invention shown in FIG.7 has almost the same configuration as that of the third embodiment, and a difference thereof is a point that the upper communicating tube 47 also functions as a partitioning plate, and other points including its effect are not different, so that description of the fourth embodiment is omitted herein.

In the fifth embodiment of the present invention shown in FIG.8, the water reserving section 42 has a big water reserving body 62 like a big bath or a hot water swimming pool, and in a case like this, a plurality of flanges 64 are mounted on the base of the water reserving body 62, a flange 63 for each individual heat exchanger 41 is connected with a bolt nut 61, and if work for checking, repairing, or replacement is required for each of the heat exchangers 41, the work is carried out after only the corresponding heat exchanger 41 is removed from the water reserving section 42. Thus the present application is useful when applied to such devices as a bath, a hot water swimming pool, a boiler based on a reserving system, a moving bath, a constant temperature bath, a vapor generator, a thermal chemicals bath, a thermal culture bath, a concrete solution heating apparatus, and a boiler for cooking.

Claims

1. Liquid heating apparatus comprising a heat exchanger (2;41) located in a water tank (1;43), the said heat exchanger (2,41) including an external drum (3;51) having a dual wall, the said external drum (3,51) having upper and lower combustion gas distribution chambers (5,11;45,54) defined in upper and lower sections of the dual wall and a combustion gas down-draft chamber (16;56) therebetween, an internal drum (4;44) spaced inwardly from the external drum (3,51) and having a combustion chamber (9;49) therein, a partitioned water chamber (6;46) defined between said external and internal drums, an upper communicating tube (7;47) comprising a water outlet penetrating the external drum and connecting the upper part of the said water chamber (6,46) to the exterior of the heat exchanger (2,41), a lower communicating tube (8;48) comprising a water inlet connecting the lower part of the said water chamber (6,46) to the exterior of the heat exchanger (2,41), a draft tube (10;50) penetrating the upper part of the said water chamber (6,46) and connecting the said combustion chamber (9,49) to the said upper combustion gas distribution chamber (5;45), an exhaust tube (12;52) in the lower part of the external drum (3,51), and a support cylinder (13;53) for a combustor (15;55) penetrating the said external drum (3,51) and the said water chamber (6,46) and a side wall of the internal drum (4,44), whereby water in the said tank (1,43) can circulate from the said water outlet (7;47) to the said water inlet (8;48) along the outside of the said external drum (3,51), the said exhaust tube (12,52) and the said combustor support cylinder (13,53) extending to the outside of the water tank (1,43).

2. Liquid heating apparatus as claimed in Claim 1, wherein the said lower communicating tube (8;48) is provided in the lower section of the said external drum (3;51).

3. Liquid heating apparatus as claimed in Claim 1, wherein the said lower communicating tube (8) is provided in the said exhaust tube (12).

4. Liquid heating apparatus as claimed in any of claims 1 to 3, wherein a plurality of said heat exchangers (2,41) are all located in a single water tank (1,43).

5. Liquid heating apparatus as claimed in Claim 1 or 2, wherein the said water tank (43) comprises an external casing surrounding the said heat exchanger (41) to define an external water chamber (60) between it and the said external drum (51), and a water reserving section (42) connected to the top of said external casing.

6. Liquid heating apparatus as claimed in Claim 5, including a cylindrical partitioning plate (59) extending up inside the said water reserving section (42).

7. Liquid heating apparatus as claimed in Claim 5 or 6, wherein the said water reserving section (42) has a water supply tube (57) in an upper or lower part thereof and a hot water outlet port (58) in an upper part thereof.

8. Liquid heating apparatus as claimed in any of Claims 5 to 7, wherein a plurality of said heat exchangers (41) are disconnectably connected to the said water reserving section (42) of the water tank (43).

Patentansprüche

1. Flüssigkeitserhitzer, umfassend einen Wärmetauscher (2; 41), der in einem Wassertank (1; 43) angeordnet ist, wobei der Wärmetauscher (2; 41) eine äußere Trommel (3; 51) umfaßt, die eine Doppelwand aufweist, wobei die äußere Trommel (3; 51) obere und untere Verbrennungsgasverteilkammern (5, 11; 45, 54), die in oberen und unteren Abschnitten der Doppelwand definiert sind, und eine dazwischenliegende Verbrennungsgasabwindkammer (16; 56) aufweist, eine innere Trommel (4; 44), die innen von der äußeren Trommel (3; 51) beabstandet ist und in sich eine Verbrennungskammer (9; 49) umfaßt, eine unterteilte Wasserkammer (6; 46), die zwischen den äußeren und inneren Trommeln ausgebildet ist, ein oberes Verbindungsrohr (7; 47), das einen Wasserauslaß umfaßt, der die äußere Trommel durchdringt und den oberen Teil der Wasserkammer (6; 46) mit dem Äußeren des Wärmetauschers (2; 41) verbindet, ein unteres Verbindungsrohr (8; 48), das einen Wassereinlaß umfaßt, der den unteren Teil der Wasserkammer (6; 46) mit dem Äußeren des Wärmetauschers (2; 41) verbindet; ein Zugrohr (10; 50), das den oberen Teil der Wasserkammer (6; 46) durchdringt und die Verbrennungskammer (9; 49) mit der oberen Verbrennungsgasverteilkammer (5; 45) verbindet, ein Auslaßrohr (12; 52) im unteren Teil der äußeren Trommel (3; 51) und einen Stützzylinder (13; 53) für einen Combustor (15; 55), der die äußere Trommel (3; 51) und die Wasserkammer (6; 46) und eine Seitenwand der inneren Trommel (4; 44) durchdringt, wobei Wasser in

dem Tank (1; 43) vom Wasserauslaß (7; 47) zum Wassereinlaß (8; 48) entlang der Außenseite der äußeren Trommel (3; 51) zirkulieren kann, wobei das Auslaßrohr (12; 52) und der Combustor-Stützzylinder (13; 53) sich zur Außenseite des Wassertanks (1; 43) erstrecken.

2. Flüssigkeitserhitzer nach Anspruch 1, wobei das untere Verbindungsrohr (8; 48) im unteren Abschnitt der äußeren Trommel (3; 51) vorgesehen ist.

3. Flüssigkeitserhitzer nach Anspruch 1, wobei das untere Verbindungsrohr (8) im Auslaßrohr (12) vorgesehen ist.

4. Flüssigkeitserhitzer nach einem der Ansprüche 1 bis 3, wobei eine Vielzahl der Wärmetauscher (2; 41) alle in einem einzigen Wassertank (1; 43) angeordnet sind.

5. Flüssigkeitserhitzer nach Anspruch 1 oder 2, wobei der Wassertank (43) ein äußeres Gehäuse, das den Wärmetauscher (41) umgibt, um eine äußere Wasserkammer (60) zwischen sich und der äußeren Trommel (51) festzulegen, und einen Wasserspeicherabschnitt (42), der mit dem oberen Teil des äußeren Gehäuses verbunden ist, umfaßt.

6. Flüssigkeitserhitzer nach Anspruch 5, der eine zylindrische Unterteilungsplatte (59) umfaßt, die sich innerhalb des Wasserspeicherabschnitts (42) erstreckt.

7. Flüssigkeitserhitzer nach Anspruch 5 oder 6, wobei der Wasserspeicherabschnitt (42) ein Wasserversorgungsrohr (57) in seinem oberen oder unteren Teil und einen Heißwasserauslaßanschluß (58) in seinem oberen Teil aufweist.

8. Flüssigkeitserhitzer nach einem der Ansprüche 5 bis 7, wobei eine Vielzahl der Wärmetauscher (41) lösbar mit dem Wasserspeicherabschnitt (42) des Wassertanks (43) verbunden sind.

Revendications

1. Appareil pour chauffer un liquide, comprenant un échangeur de chaleur (2 ; 41) qui est placé dans une cuve à eau (1 ; 43) et qui comporte un réservoir extérieur (3 ; 51) à paroi double comportant lui-même des chambres de distribution de gaz de combustion supérieure et inférieure (5, 11 ; 45, 54) définies dans des sections supérieure et inférieure de la paroi double, et une chambre de tirage descendant de gaz de combustion (16 ; 56) disposée entre lesdites chambres de distribution ; un réservoir intérieur (4 ; 44) disposé avec un espacement à l'intérieur du réservoir extérieur (3 ; 51) et contenant une chambre de combustion (9 ; 49) ; une chambre à eau cloisonnée (6 ; 46) définie entre les réservoirs extérieur et intérieur ; un tube de liaison supérieur (7 ; 47) présentant une sortie d'eau qui traverse le réservoir extérieur, et reliant la partie supérieure de la chambre à eau (6 ; 46) à l'extérieur de l'échangeur de chaleur (2 ; 41) ; un tube de liaison inférieur (8 ; 48) présentant une arrivée d'eau qui relie la partie inférieure de la chambre à eau (6 ; 46) à l'extérieur de l'échangeur de chaleur (2 ; 41) ; un tube d'aspiration (10 ; 50) qui traverse la partie supérieure de la chambre à eau (6 ; 46) et qui relie la chambre de combustion (9 ; 49) à la chambre de distribution de gaz de combustion supérieure (5 ; 45) ; un tube d'échappement (12 ; 52) prévu dans la partie inférieure du réservoir extérieur (3 ; 51) ; et un cylindre de support (13 ; 53) pour un brûleur (15 ; 55), qui traverse le réservoir extérieur (3 ; 51), la chambre à eau (6 ; 46) et une paroi latérale du réservoir intérieur (4 ; 44), moyennant quoi l'eau qui se trouve dans la cuve (1 ; 43) peut circuler entre la sortie d'eau (7 ; 47) et l'arrivée d'eau (8 ; 48) en longeant le côté extérieur du réservoir extérieur (3 ; 51), le tube d'échappement (12 ; 52) et le cylindre de support de brûleur (13 ; 53) qui s'étend vers l'extérieur de la cuve à eau (1 ; 43).

2. Appareil pour chauffer un liquide selon la revendication 1, dans lequel le tube de liaison inférieur (8; 48) est disposé dans la section inférieure du réservoir extérieur (3 ; 51).

3. Appareil pour chauffer un liquide selon la revendication 1, dans lequel le tube de liaison inférieur (8) est disposé dans le tube d'échappement (12).

4. Appareil pour chauffer un liquide selon l'une quelconque des revendications 1 à 3, dans lequel plusieurs échangeurs de chaleur (2 ; 41) sont tous placés dans une seule cuve à eau (1 ; 43).

5. Appareil pour chauffer un liquide selon la revendication 1 ou 2, dans lequel la cuve à eau (43) comprend un carter extérieur qui entoure l'échangeur de chaleur (41) afin de définir entre celui-ci et le réservoir extérieur (51) une

chambre à eau extérieure (60), et une section de réserve d'eau (42) reliée au haut du carter extérieur.

6. Appareil pour chauffer un liquide selon la revendication 5, comportant une plaque de cloisonnement cylindrique (59) qui s'étend vers le haut et pénètre dans la section de réserve d'eau (42).

7. Appareil pour chauffer un liquide selon la revendication 5 ou 6, dans lequel la section de réserve d'eau (42) contient, dans une partie supérieure ou inférieure, un tube d'amenée d'eau (57) et, dans une partie supérieure, une ouverture de sortie d'eau chaude (58).

8. Appareil pour chauffer un liquide selon l'une quelconque des revendications 5 à 7, dans lequel plusieurs échangeurs de chaleur (41) sont reliés de manière démontable à la section de réserve d'eau (42) de la cuve à eau (43).

FIG. 1

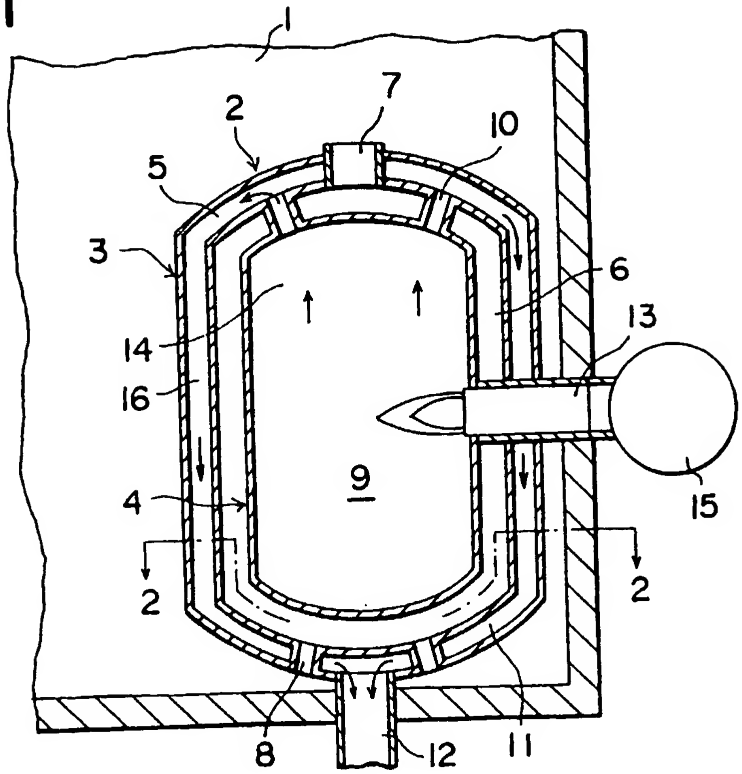

FIG. 2

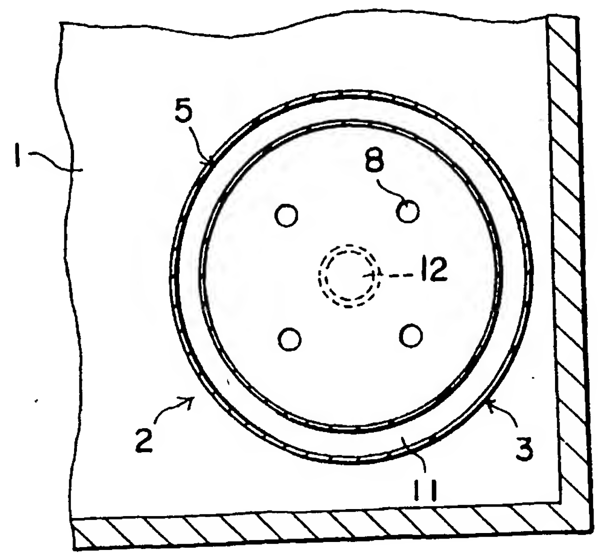

FIG. 3

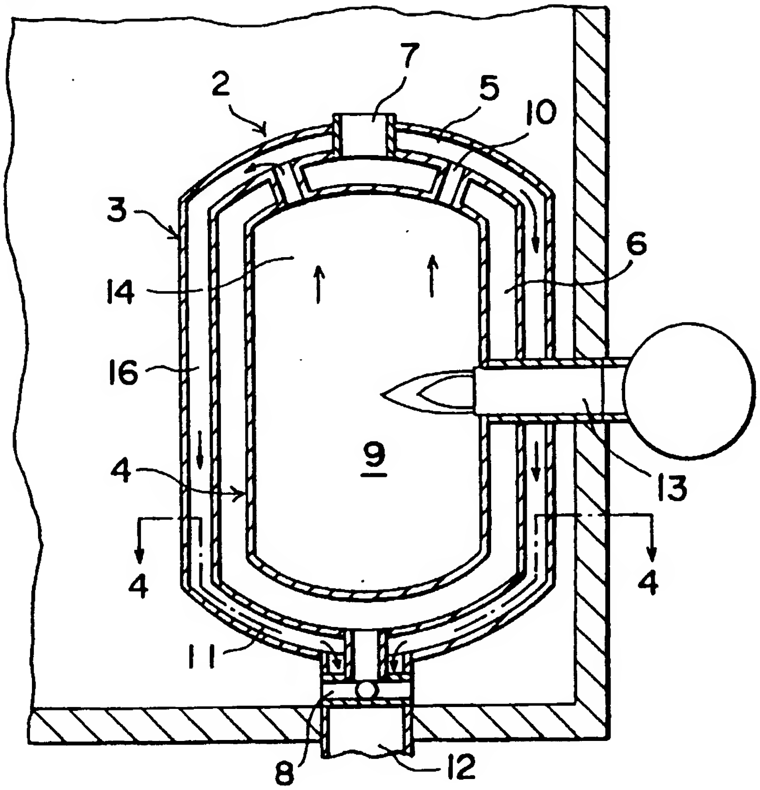

FIG. 4

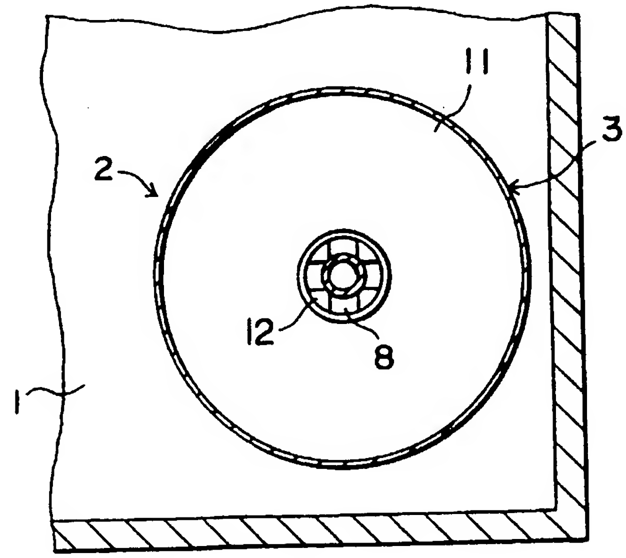

FIG. 5

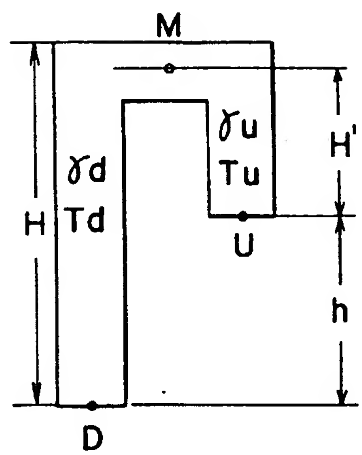

FIG. 6

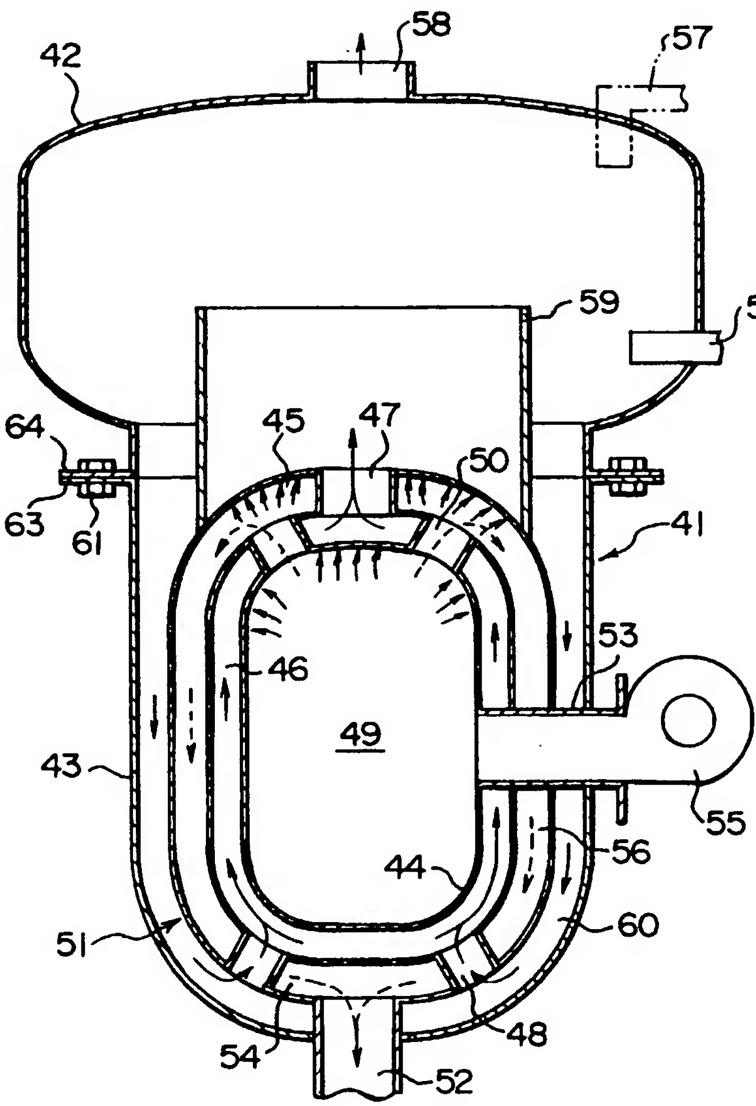

FIG. 7

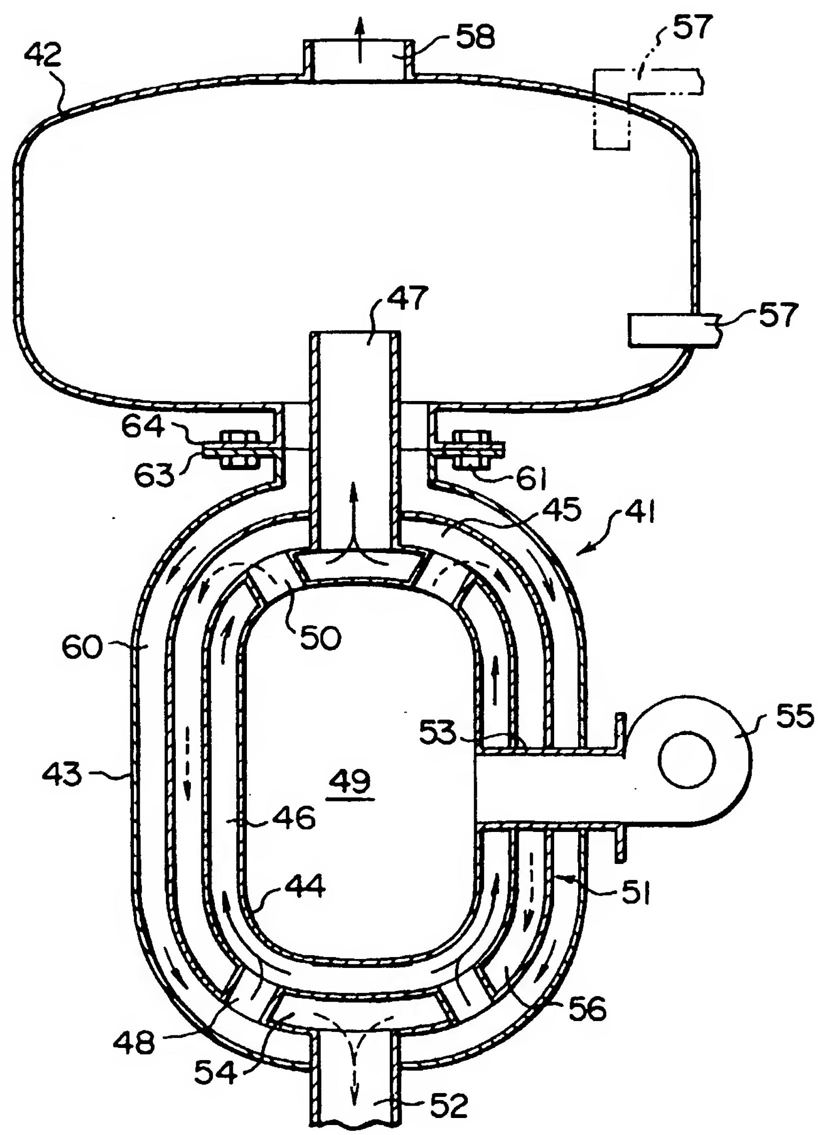

FIG. 8

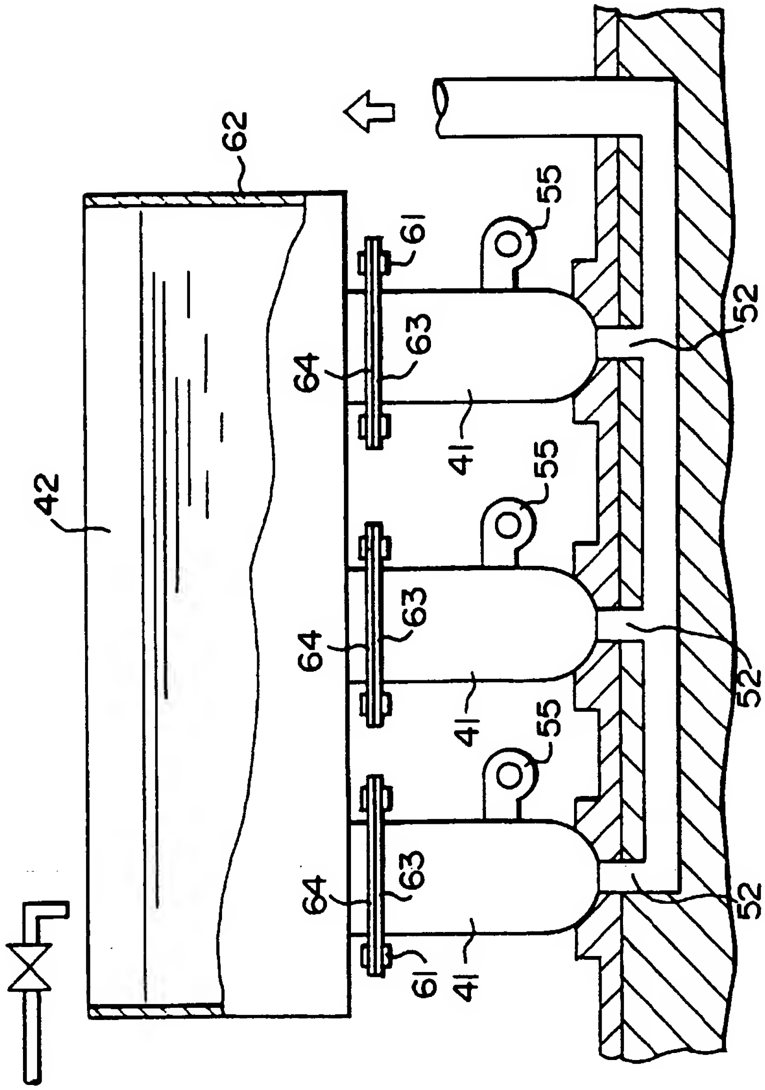

FIG. 9
PRIOR ART

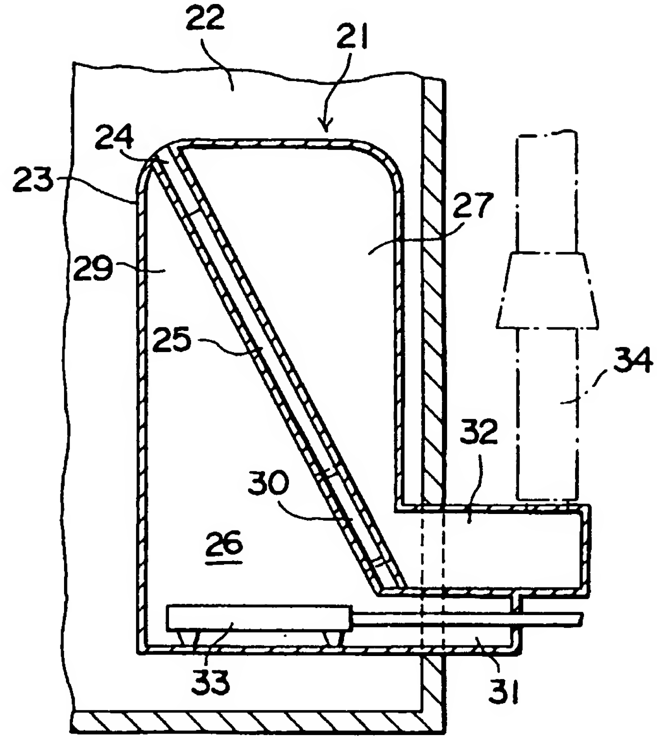

FIG. 10
PRIOR ART

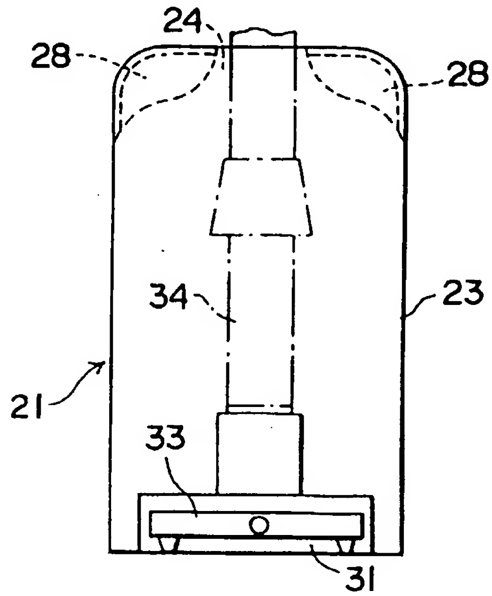

FIG. 11
PRIOR ART

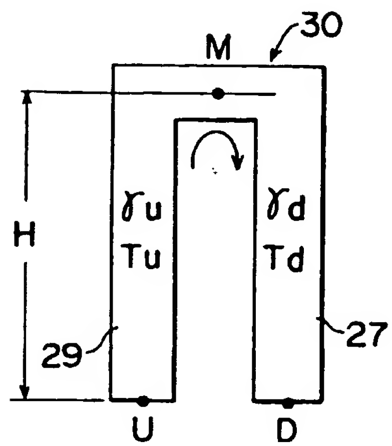

FIG. 12
PRIOR ART

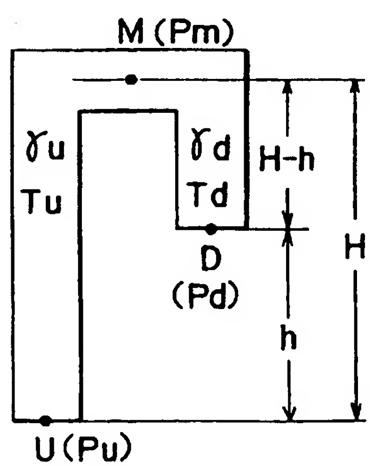

FIG. 13
PRIOR ART

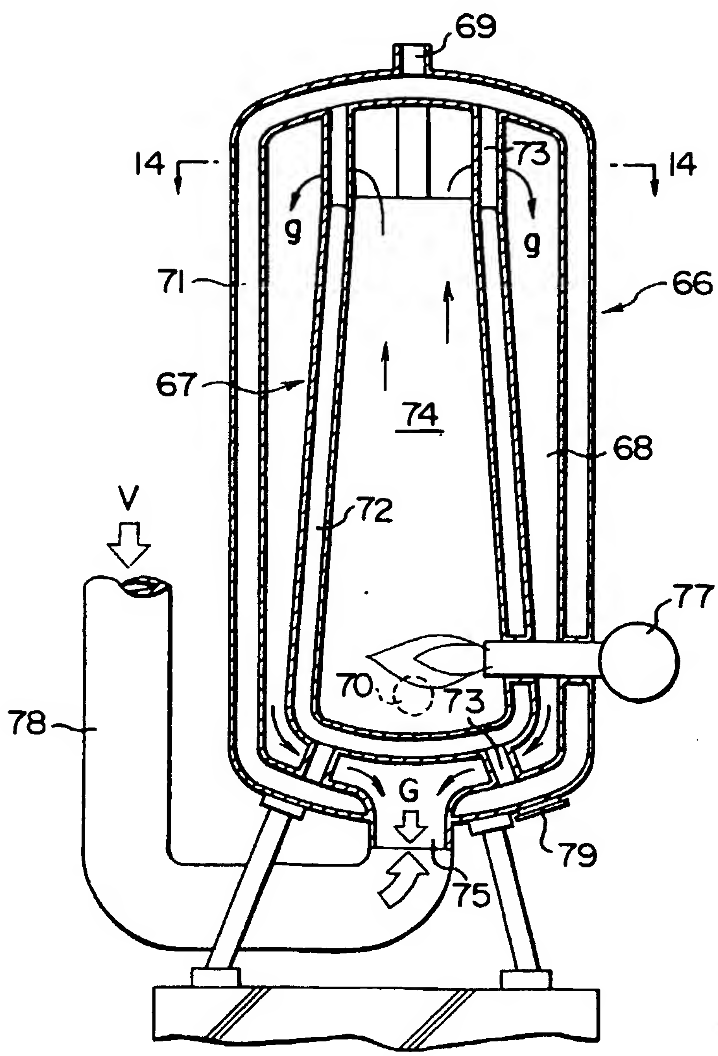

FIG. 14
PRIOR ART